SB
818
C578
ENT

CIRCULAR NO. 8, SECOND SERIES.

United States Department of Agriculture.

DIVISION OF ENTOMOLOGY.

THE IMPORTED ELM LEAF-BEETLE.

Galerucella luteola Mull. (*Galeruca xanthomelæna* Schrank.)

FIG. 1.—*Galerucella luteola: a*, eggs; *b*, larvæ; *c*, adult; *e*, eggs (enlarged); *f*, sculpture of egg; *g*, larva (enlarged); *h*, side view of greatly enlarged segment of larva; *i*, dorsal view of same; *j*, pupa (enlarged); *k*, adult (enlarged); *l*, portion of elytron of beetle (greatly enlarged). From Riley, in Ann. Rept. Dept. Agr. for 1883.

GENERAL APPEARANCE AND METHOD OF WORK.

The chief insect enemy of the elm is the imported elm leaf-beetle, the larvæ and adults of which frequently so disfigure the trees as to make them useless for shade and hideous rather than ornamental. The beetle—a small, yellowish-brown insect—appears first and fills the leaves with small irregular holes, while the following broods of slug-like yellow and black larvæ skeletonize the leaves

15162—No. 8—06 M

in irregular spots between the veins, working on both surfaces, but chiefly on the lower side, causing the leaves to assume a dry, brown appearance, to curl, and ultimately to fall. The second crop of leaves sent out by the trees in the southern range of the insect meets a like fate.

DISTRIBUTION.

The elm leaf-beetle is a well-known depredator in the Old World, particularly in south Germany, Austria, and France. It was imported into this country, on the authority of Glover, in 1837, and its earliest attacks were particularly severe about Baltimore and in New Jersey. Its spread in this country has been comparatively slow, and, while wherever it has appeared it has established itself very firmly and now frequently occurs in enormous numbers, it is limited in its range, so far as the records go, to the middle Atlantic seaboard, including the District of Columbia, Maryland from Washington eastward, Virginia in the immediate vicinity of Washington, Delaware, southeastern Pennsylvania, New Jersey, Long Island, the Hudson River Valley, and southern Connecticut. On the authority of Prof. C. H. Fernald it is not known to occur in Massachusetts, and Prof. Gerald McCarthy reports the same for North Carolina. This range, as pointed out by Mr. Howard, practically conforms to the northern limit of the upper austral life zone, outside of which the insect has not established itself as yet, so far as can be learned.

NATURAL HISTORY AND HABITS.

Characteristics of Different Stages.—The insect occurs on the trees in three different stages, and the fourth stage is passed on or under the surface of the ground at the base of the tree; i. e., the egg, larva, and beetle on the tree, the pupa in the ground.

The beetle is a little over a quarter of an inch long, of a general yellowish or yellowish-brown color, with three somewhat indistinct brownish-black stripes on the wings. It is shown natural size at *c*, and enlarged at *k*, in the figure.

The eggs are placed on the lower sides of the leaves in vertical clusters of from 5 to 20 or more eggs, closely arranged in two or three irregular rows. They are oblong-oval in shape, tapering to a rather obtuse point, orange yellow in color, and the exterior surface is covered with beautiful hexagonal reticulations. They are shown natural size on the leaf at *a*, and enlarged at *e*, with the reticulated surface still more enlarged at *f*.

The larva is elongate, reaching a length of about half an inch, and when newly hatched is nearly black. As it increases in size it becomes, with each shedding of the skin, more distinctly marked with yellow, and when mature the yellow predominates, occurring as a broad dorsal stripe and two lateral stripes. The larva is represented natural size on the leaves, and somewhat enlarged at *g*, with portions still more enlarged at *h* and *i* in the figure.

The pupa is uniformly light orange yellow, oval in shape, strongly convex dorsally, and a little over a quarter of an inch in length. It is shown in the illustration at *j*, enlarged.

The egg state lasts about a week, and the larva normally fifteen to twenty days, and the pupa six to ten days.

Number of Broods and Dates of Appearance.—In the more southern range of this insect, including Maryland, Virginia, Delaware, and most of New Jersey, there are two annual broods, with an occasional small third generation. Farther north, including northern New Jersey, Long Island, New York State, and

Connecticut, there is in general but one well-marked brood, with sometimes a supplemental or partial second brood.

Throughout the double-brooded area the beetles make their appearance in spring about the middle of April, beginning to come out before the elms have put out their leaves and continuing on the trees through May, perishing soon after egg-laying is finished. The eggs of the first brood are deposited during May and into June, the larvæ of this brood occurring from early in May throughout June. Pupation takes place during June and July, and beetles of the second or summer brood emerge during July and into August. The eggs for the second brood of larvæ are deposited by these beetles from the middle of July through August, and the larvæ of the second brood skeletonize the second growth of elm leaves during the latter part of July and August, the later specimens occurring up to October. Pupation occurs chiefly during August and September, the beetles appearing from the last of August through September, and entering winter quarters during September and October.

In the one-brooded regions the beetles do not appear in spring until the last of May, and, in general, the periods are fully a month later for the different stages than for the southern districts, the beetles of the summer brood transforming most abundantly about the first of August. After feeding on the leaves a little while, and doing very inconsiderable damage, they go into winter quarters during August and September, remaining dormant eight or nine months.

Habits of Larvæ and Hibernation of Adults.—The larvæ from each batch of eggs feed together somewhat gregariously for a time, but ordinarily become separated and scattered later, especially with a scantiness of food. When full grown they normally crawl down the branches to the trunk and then to the ground, pupating almost immediately on or very near the surface of the soil just about the base of the tree. They are apt to seek partial protection about grass bunches, but frequently accumulate in masses, exposed on the surface in such a manner as to make a striking yellow carpet about the tree from a few inches to a foot or more wide. With very large elms, however, many of the larvæ are shaken off by winds or fall directly to the ground, sometimes fairly covering the surface over a diameter equal to the limb-expanse of the tree.

Hibernation is in the adult state both where there is but one brood and where there are two. For this purpose the beetles frequently enter houses and barns or outbuildings, sometimes assembling in such numbers that it is possible to collect them by the quart. They also enter cracks in posts, telegraph poles, fences, etc., or wherever they can secure partial protection from winter storms.

Susceptibility of Different Elms.—European elms seem to be especial favorites with this insect, and this would naturally be expected from its European origin. Its preference for the European elms is especially noticeable where these are grown in conjunction with American elms, the former being frequently entirely denuded, while the latter remain practically uninjured. In general, the coarser-leaved sorts of elms are distasteful to the beetles, and the smooth, thin-leaved varieties are especially subject to attack. The American species, *Ulmus americana*, is notably exempt, and this, together with the general immunity of other American species, is a strong argument in favor of restricting planting to our native sorts. All species of elms, however, are attacked more or less, and in the absence of sufficient foliage of the favorite varieties, the injury to less palatable sorts becomes almost equally marked.

REMEDIES.

In nearly every stage of the life history of this insect it is easily subject to treatment. The best means against the adults and larvæ consist in the use of arsenical poisons in the form of sprays on the foliage. The adults, for a week

SMITHSONIAN INSTITUTION LIBRARIES
3 9088 01272 6642

or two after emerging, feed on the newly expanded foliage, and a spraying with Paris green or other arsenical will destroy the great majority of them. Especial pains should be taken to accomplish the destruction of the insect in this stage, in order to prevent the partial disfigurement which will result if the matter be delayed until the larvæ begin to appear. If rains interfere with spraying for the adults, or if it be neglected, the trees should be sprayed with arsenicals promptly on the first appearance of the larvæ, and the application perhaps renewed a week or ten days later, especially if rains have intervened.

Paris green is the best arsenical, and may be safely used on elms at the rate of 1 pound to 100 to 150 gallons of water. If London purple be used, an amount of lime equal to the poison in weight should be added to combine with any free arsenic and prevent scalding of foliage. The liquid should be applied with a strong force pump with a long hose and a nozzle, such as the Vermorel or Nixon, which will make a fine mist-like spray. In spraying for the larvæ it is very essential to thoroughly wet the lower side of the leaves, on which they principally feed. In the case of the adults, this is not so necessary, because they eat the entire substance of the leaf, and will get the poison from either side.

On elms 15 or 20 feet in height, the treatment can be made from the ground or from a wagon. For larger elms, it will be necessary to climb up into the tree, using a hose 50 to 100 feet long, and directing the spray by this means into the upper branches. By removing the spray tip from a large size Nixon nozzle, so as to get a direct discharge, the upper branches of comparatively tall trees may be reached and sprayed in a more or less satisfactory manner. In the case of very large elms in city parks or streets, the use of stronger apparatus may be advisable, such as a fire engine or steam pump and a larger nozzle, such as a graduating spray tip, capable of throwing either a direct stream or a spray. During spraying the poison should be constantly stirred to prevent it from settling to the bottom of the tank.

The first effort should be to destroy the beetles and larvæ at their earliest appearance, to save the trees for the current year. Sometimes, however, larvæ in the tops of tall trees will escape, and, whenever from inefficient spraying or neglect they are allowed to reach maturity, a strong effort should be made to destroy the insect when it reaches the ground to transform, and thus limit or prevent damage from the second brood or in the following year. The collection of the larvæ for pupation, frequently in enormous numbers immediately about the base of the tree, makes it comparatively easy to destroy them in this situation. This may be accomplished either by wetting them with boiling water or with kerosene emulsion, diluted about four times. Frequently they may be collected by hand or shoveled up, and burned or otherwise destroyed.

Remedial treatment is much simpler in the northern areas of the range of this insect, where it is single-brooded, and becomes more difficult in the southern districts, where the number of broods is doubled, and the appearance of the insect becomes somewhat irregular, continuing practically throughout the summer.

C. L. Marlatt,
First Assistant Entomologist.

Approved.
Chas. W. Dabney, Jr.,
Assistant Secretary.

Washington, D. C., *May 23, 1895.*

[Cir. 8]

O